

What is claimed is:

1. A tunable phase shifter comprising;
a waveguide;
a finline substrate positioned within the waveguide;
5 a tunable dielectric layer positioned on the finline substrate;
a first conductor positioned on the tunable dielectric layer; and
a second conductor positioned on the tunable dielectric layer, the first and
second conductors being separated to form a gap.
2. A tunable phase shifter according to claim 1, wherein:
10 the gap extends from a first end of the tunable dielectric layer to a second
end of the tunable dielectric layer;
the gap includes a first end, a center portion and a second end; and
the gap includes exponentially tapered portions adjacent to said first and
second ends.
3. A tunable phase shifter according to claim 2, wherein the gap has a
15 minimum width ranging from 2 micron to 50 micron.
4. A tunable phase shifter according to claim 1, further comprising:
a voltage source for applying a control voltage between the first conductor
and the second conductor.
5. A tunable phase shifter according to claim 1, wherein the second
20 conductor forms an RF ground.
6. A tunable phase shifter according to claim 1, wherein the second
conductor comprises:
an RF choke.
7. A tunable phase shifter according to claim 1, wherein the waveguide
25 includes first and second sections, and the tunable phase shifter further comprises:
a first conductive plate positioned between the first and second sections of
the waveguide; and
a second conductive plate positioned between the first and second sections of
30 the waveguide, the first conductive plate being insulated from the waveguide and the second
conductive plate being electrically connected to the waveguide.

8. A tunable phase shifter according to claim 7, further comprising an impedance matching section formed by a gap between the first and second conductive plates.

9. A tunable phase shifter according to claim 8, wherein the impedance matching section comprises:

an exponentially tapered gap between the first and second conductive plates.

10. A tunable phase shifter according to claim 1, wherein:

the first conductor is insulated from the waveguide and includes an RF ground; and

the second conductor is electrically connected to the waveguide.

11. A tunable phase shifter according to claim 10, further comprising an impedance matching section formed by a gap between the first and second conductors.

12. A tunable phase shifter according to claim 11, wherein the impedance matching section comprises:

an exponentially tapered gap between the first and second conductors.

13. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises a material selected from the group of:

barium strontium titanate, barium calcium titanate, lead zirconium titanate, lead lanthanum zirconium titanate, lead titanate, barium calcium zirconium titanate, sodium nitrate, KNbO_3 , LiNbO_3 , LiTaO_3 , PbNb_2O_6 , PbTa_2O_6 , $\text{KSr}(\text{NbO}_3)$, $\text{NaBa}_2(\text{NbO}_3)_5$, KH_2PO_4 , and combinations thereof.

14. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises a barium strontium titanate (BSTO) composite selected from the group of:

BSTO-MgO, BSTO-MgAl₂O₄, BSTO-CaTiO₃, BSTO-MgTiO₃, BSTO-MgSrZrTiO₆, and combinations thereof.

15. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises a material selected from the group of:

Mg₂SiO₄, CaSiO₃, BaSiO₃, SrSiO₃, Na₂SiO₃, NaSiO₃·5H₂O, LiAlSiO₄, Li₂SiO₃, Li₄SiO₄, Al₂Si₂O₇, ZrSiO₄, KAlSi₃O₈, NaAlSi₃O₈, CaAl₂Si₂O₈, CaMgSi₂O₆, BaTiSi₃O₉ and Zn₂SiO₄.

16. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer comprises:

an electronically tunable dielectric phase and at least two metal oxide phases.

17. A tunable phase shifter according to claim 1, wherein the tunable dielectric layer has a dielectric constant at zero bias voltage ranging from 30 to 2000.

18. A tunable phase shifter according to claim 1, wherein the a finline substrate comprises:

a low loss, low dielectric material.